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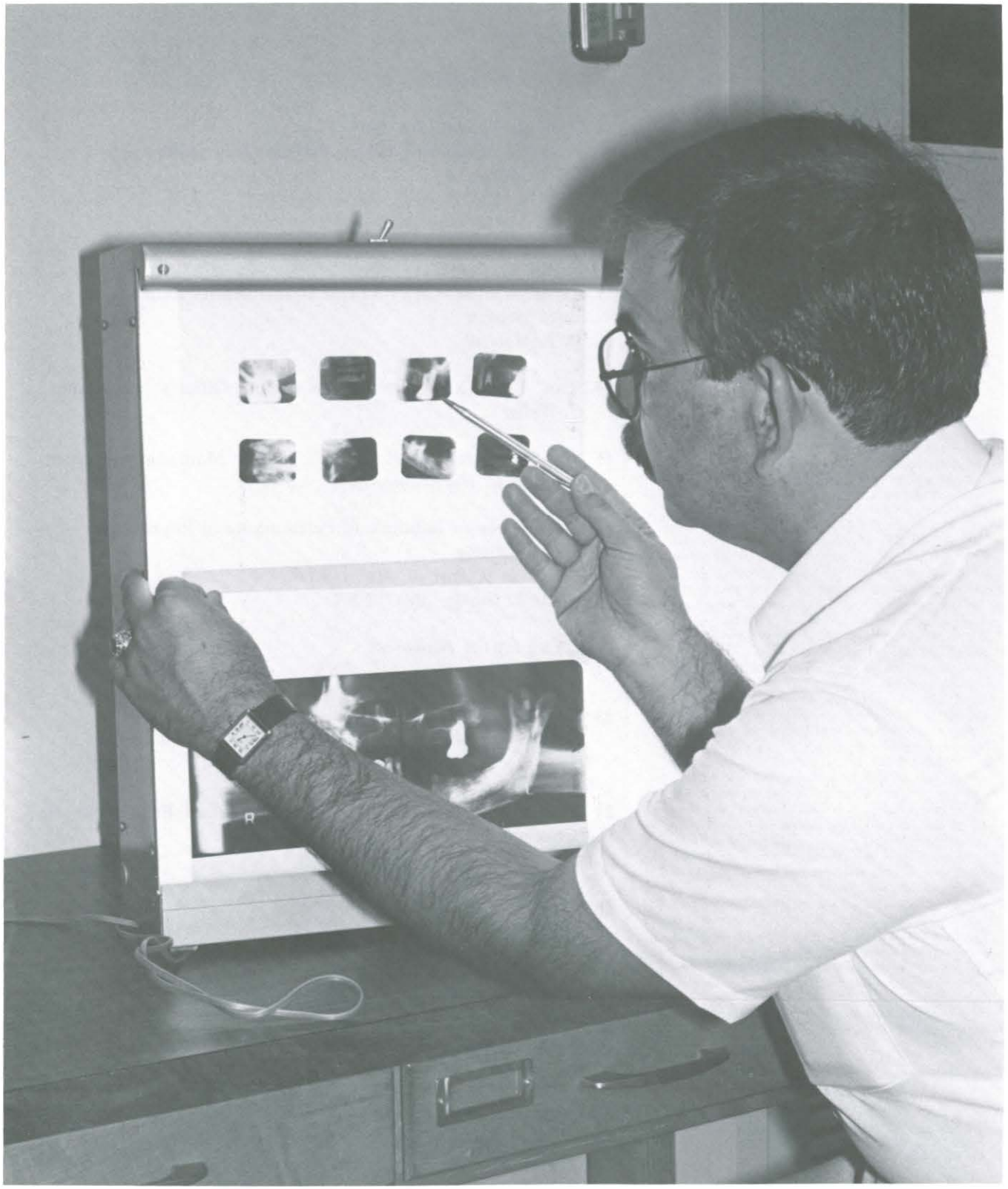
July-August 1986



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COVER: Forensic odontologist CAPT Lowell Levine, MC, USNR, studies X-rays of Nazi war criminal Josef Mengele. Dr. Levine was a member of the team that identified remains of the infamous "Angel of Death." Story on page 8. Photo by the Editor.

Disaster at Sea

Personnel prepare to medevac a patient.

The holiday makers crowded onto the last inter-island ferry for Manila before Christmas, anxious to join their families and friends for the extended celebrations of the most important holiday of the year. Palawan is an island to the south far from the capital of Luzon, and airfare was beyond the reach of most. So they came aboard, mothers and babies, schoolchildren released from their studies, breadwinners, entire families for the most part; 200 people by their own estimate.

That night the ship began to list in the heavy seas, lost engine power, and slowly took on water. In a desperate attempt to survive, they threw overboard some of the cargo—198 pigs, 9 cows, and tons of dried and fresh seafood. Nevertheless the vessel sank at daybreak about 8 miles from the island of Lubang. Floating in life jackets, clinging to the many bundles of rattan and wicker that had been on her decks, the passengers awaited rescue.

The rescue effort was massive. Ships changed course and brought aboard survivors and their dead. Navy patrol planes of VP-22 directed the search, dropped SAR kits with life rafts, and vectored in the helos of VC-5 which picked up more survivors. NAS Cubi Point air traffic controllers directed the heavy traffic. NAVHOSP Subic Bay triaged the survivors as they arrived at Cubi Point and Subic Bay. They also sent doctors and corpsmen to an MSC contract ship, the tanker SS Overseas Alice, *for the 50 survivors there. COMUSNAVPHIL coordinated the entire effort. The following account is one flight surgeon's perspective. Of necessity, many heroes are left unsung.*

When the phone rang, the opening words were all too familiar. "The helo is turning and they need a flight surgeon in 10 minutes." What followed was altogether different. "It's an actual SAR, number of survivors unknown." The butterflies in my stomach were doing aerobatics as I dashed for the flight line.

As the SAR swimmers picked survivors out of the water, I administered necessary medical care during the 45-minute flight back from the disaster site. The patients were then turned over to waiting ambulances. At first glance, this all seemed to be a routine scenario. How wrong I was.

The helo came in close to a slight form in a bright orange life jacket, wearing lavender slacks and tennis shoes. The cheerful colors suggested a lively youthful person, and added to the shock of discovering that the body was face down. The SAR swimmer suspended his rescue preparations and instead threw down a dye marker to aid in later recovery. We found three more bodies but no survivors. Low on fuel, the helo had turned back when the crewman asked if I wanted to be lowered by hoist to the deck of a ship with 50 survivors aboard. Knowing that the cargo (me) would be dumped if there were any problems with the hoist or helo, I felt there were many other places I would rather be. Unable to think of a graceful excuse, I was soon pushed out the door to dangle 50 feet over a steel deck. It turned out to be more fun than an E ride at Disneyland, but the fun was soon over.

The crew took me below to their ship's hospital, a tiny room with two bunk beds and nearly 20 people. The crew had done a marvelous job of first aid and organization. Their hospital became the women's ward, with a mattress on the deck for the two "ICU" patients. The crew lounge became the men's ward, and ambulatory of both sexes were in the connecting passageway, along with a few women in worse condition. The women had tolerated the long hours in the water fairly well, but most of the men had been very hypothermic when rescued. The third mate hauled them into a hot shower and blocked the air-conditioning vents. The chief cook fed them all warm broth. Blankets were broken out. The most serious medical problem was appropriately treated before any medical help arrived.

Everything I knew about triage presupposed there was some place to triage to and that patients were sorted

and sent to the appropriate way station or on for definitive care. What do you do when you alone are the sum total of available medical care? Previous training takes over and you automatically do what is needed. See and sort! Examination was necessarily abbreviated and, for most, consisted of "eyeballing." Were they alert, either upright or ambulatory, and were they behaving appropriately for the situation? Those with vacant faces, or in obvious pain, or those who were lying down received more careful scrutiny.

This second sorting left me with a handful of patients about whom I was concerned. These got blood pressure checks and orders for oral fluids. Hypothermia had resolved itself; the spaces had become stiflingly hot with too many people and no air flow. We opened a hatch and uncovered the vents to reduce insensible fluid loss.

The two remaining patients were the women the crew had already sorted onto the "ICU" mattress. One was a young woman who had been in the water nearly 24 hours and had sustained severe abrasions to her arms and neck, sunburn to her face, and conjunctivitis to the extent that her eyes were swollen shut. These injuries occurred to a lesser extent in all the survivors. A kapok life jacket, when wet and salt-encrusted, acts like sandpaper and rubs away the skin, leaving an open, weeping surface with the appearance of a burn. Water temperatures in the South China Sea are high enough to permit survival after extended immersion. Shock and the adverse effects of exposure persisted in many. The mechanical effects of wave action and thermal effects of the Sun (and perhaps chemical and/or bacterial contamination near the sinking) combined to produce a marked conjunctival infection (with the appearance of epidemic hemorrhagic keratoconjunctivitis) in nearly all and a purulent discharge in most. Many had minor abrasions and lacerations from the life-saving rattan and wicker, a few had more severe puncture wounds and lacerations. None had major trauma.

My main concerns about the young woman were her low blood pressure and her unresponsiveness. She moaned and seemed incoherent. The other woman was in her 50's, seemed alert and oriented, looked frail but in no acute distress, and had an unobtainable blood pressure by ascultation, 80 systolic by palpation. The picture didn't quite compute; my feeling was that she normally had such a blood pressure and probably needed a pediatric cuff to get an accurate reading. I started two IV's and medevaced her at the earliest opportunity. She did well and was released from the hospital the next day.

After evaluating everyone and stabilizing the sickest, I went back to offer what comfort I could to the majority. Most were in moderate pain and requested relief for their abrasions and musculoskeletal aches. Codeine tablets, sulfacetamide eye ointment, and bacitracin seemed the most useful of the ship's medicines. One of the women who had lost her husband and only child was put to work recording names and dosages as I dispensed the medicines. It proved to be good therapy for her, and I eventually gave other people distractive tasks to help them cope with massive losses. A 15-year-old girl had lost her entire family of six. A man grieved with his remaining children for his wife and 4-year-old son. A mother brought aboard her 8-month-old son and didn't want to release him to the makeshift morgue in the ship's reefer. A father described how his young son, strapped to his back, become quieter and weaker until he died a few hours before rescue. A mother wrestled with her guilt at having to let go of the bodies of her two children in order to be pulled aboard herself. The strength and resilience of these people were remarkable and impressive. Treatment of grief reactions over the next 2 days was primarily by sympathetic listening and touching, and a very few Valium for those who were most distraught.

Suddenly a familiar and very welcome face appeared in the doorway. LT Robert Petty, my colleague from Cubi Dispensary and fellow Naval Hospital flight surgeon and a former Green Beret medic in Vietnam, was just the person I most wanted to see. He had brought two corpsmen and more supplies. LT Petty went to work on the "ICU" patients; one corpsman took vital signs, and the Tagalog-speaking corpsman began the important task of recording names, ages, and residences of all the survivors.

The Cubi Clinic LCPO and the NAS chaplain arrived shortly. Their helo had picked up the last survivor, who had been in the water for 33 hours. He was the only one whose sole means of flotation was his life preserver. It was extremely difficult to see life rafts and nearly impossible to see people low in the water, even though the storm had passed and the 12 to 15-foot waves were reduced to gentle swells. One man was found because his gold watch glinted in the sun as he grasped a board for support. The last man had only a life vest, a strong will to live, and excellent conditioning. He walked off the helo and was greeted below by his brother who had thought him dead.

Four patients were eventually medevaced, the two women, a 14-year-old with pneumonia, and a man with a puncture wound of the foot. Those who remained all developed infections in their abrasions, with marked suppuration. An ocean seems like the ultimate bathtub, but apparently the water was contaminated (possibly by the cargo of animals). This led to concern about tetanus, so tetanus-diphtheria toxoid was requested and administered to all.

After 2 days and 1 night at sea, the shipboard survivors were taken from pierside to an Olongapo hospital. Naval hospital personnel triaged other survivors flown in by helo, transported all survivors to the local hospital, and assisted in their transfer to Manila the next day. □

Story by CDR Elizabeth K. Ledbetter, MC, Director, Branch Clinic Miramar, San Diego, CA. Photos by JO2 Joseph E. Lancaster, COMUSNAVPHIL Public Affairs.

Malnutrition in Hospitalized Patients

Recognition and Initial Management

CDR Ann Meyers, MC, USN
CDR Gary P. Zaloga, MC, USN

Cellular metabolism and integrity are maintained by the constant influx of nutrients into the cell and efflux of waste products out of the cell. Interruption of these processes will result in impaired cellular function and at times cellular death. Oxygen is the most vital of all cellular nutrients and deprivation of this nutrient, for even a few minutes, can cause irreversible organ dysfunction (e.g., myocardial infarction, stroke). Deprivation of other cellular nutrients such as glucose, amino acids, vitamins, minerals, and fatty acids can also impair organ function and if deprivation is prolonged death can result.

Inadequate nutritional repletion carries with it substantial morbidity and mortality *above and beyond* the primary disease process. Recent data has shown that malnutrition can impair wound healing, depress immune responses, increase the incidence of clean wound infection and sepsis, prolong postoperative ileus, increase the incidence of respiratory infection and insufficiency, impair the ventilatory responses to hypoxia and hypercarbia, delay weaning time for patients on ventilators, prolong hospitalization, and increase mortality. These abnormalities are reversible with nutritional repletion. For these reasons, malpractice claims have recently been filed against surgeons who have had infectious complications following elective surgery in malnourished patients. Some claims have been won based upon the failure of the physician to recognize and treat malnutrition prior to surgery.

Recent surveys conducted in both teaching and nonteaching hospitals reveal that 30-50 percent of patients entering the hospital have signs and symptoms of malnutrition. Malnutrition-induced immune compromise contributes to many of these hospitalizations. When illness or injury occur, metabolic alterations result in increased energy needs and nitrogen requirements and malnutrition-induced deficiencies in organ function can occur within days of illness. Once hospitalized, many additional patients develop malnutrition in front of our eyes. Frequently, these patients go unrecognized. As many as 20-30 percent develop malnutrition following hospitalization.

Reasons for the in-hospital development of malnutrition include loss of appetite, poor staff encouragement of eating, hypocaloric feedings, NPO status, preparation for various diagnostic tests, use of medications which produce anorexia, lack of recognition of poor nutritional status, and delay in initiating nutritional repletion. Since malnutrition has such a tremendous impact upon illness duration and outcome it is essential that all health care providers be capable of assessing the nutritional status of their patients and beginning initial nutritional repletion.

This article will describe methods for assessing the nutritional status of patients. Nutritional assessment is the means by which one diagnoses, characterizes, and quantitates malnutrition. It also provides a mechanism for monitoring the therapeutic response to nutritional support. It is important that health providers realize that the yield from nutritional assessment is higher than the yield from many other hospital studies that most patients routinely receive on admission to the hospital such as EKG, chest X-ray, and urinalysis. In addition, the routine of administering nutritional support without baseline and serial nutritional assessments is analogous to providing blood transfusions without having determined the hematocrit before or after transfusion.

Nutritional Assessment

Nutritional assessment and initial nutritional therapy should begin immediately following resuscitation and stabilization of the patient. It is not desirable to wait any longer than necessary before beginning therapy

Dr. Meyers is attending physician, Endocrinology and Clinical Nutrition, Naval Hospital, Bethesda, and assistant professor of medicine, Uniformed Services University of the Health Sciences (USUHS), Bethesda, MD 20814. Dr. Zaloga is director, Critical Care Medicine Research, and director, Clinical Nutrition Service at the same hospital. He is also assistant professor of medicine, USUHS.

TABLE 1
Clinical Features of Micronutrient Deficiencies

Vitamin	*Deficiency*
A (Retinol)	Loss of membrane integrity Xerophthalmia, keratomalacia Increase risk of infection Loss of cilia Folliculosis Growth failure Night blindness
B_1 (Thiamine)	Beriberi (heart failure, neuritis, mental disturbances) Wernicke's encephalopathy Korsokoff's syndrome
B_2 (Riboflavin)	Stomatitis, cheilosis, glossitis, dermatitis
B_3 (Pantothenic Acid)	Neuropathy, sleep disturbance, fatigue, personality change
B_6 (Pyridoxine)	Anemia, weakness, irritability, seizures, depression, insomnia, glossitis, cheilosis, stomatitis, dermatitis
Biotin	Eczemalike dermatitis, hair loss, muscle atrophy, depression
B_{12} (Cyanocobalamin)	Megaloblastic anemia, neuritis, diarrhea, glossitis
Niacin	Dermatitis, depression, diarrhea, dementia, glossitis, stomatitis, cheilosis
K (Naphthoquinones)	Bleeding, coagulopathy
C (Ascorbic Acid)	Scurvy, bleeding gums, hemorrhage, poor wound healing, fracture, loosened teeth
D (Cholecalciferol)	Hypocalcemia, osteomalacia
Folate	Megaloblastic anemia, diarrhea, glossitis

since malnutrition of even a few days duration may result in complications. It will be much more difficult to replenish the patient once complications develop and depletion is greater. Recent experience suggests that the incidence of in-hospital sepsis may be decreased substantially by early nutritional support. It is well established that immune responses become impaired and bowel atrophy occurs within days of starvation and both may lead to bacterial invasion.

Nutritional assessment begins with the clinical history and physical examination. The dietary history should include a description of food consumption patterns, eating habits, and meal composition. Circumstances of food purchase, storage, and preparation are important. Many elderly patients are susceptible to malnutrition because of low incomes, poor access to food stores, inadequate cooking facilities, lack of ambition to prepare well-balanced meals, and poor eating habits. One should obtain enough of a history to estimate caloric intake and caloric expenditures. Nutritional textbooks contain charts which list the caloric content of various foods and the caloric expenditures for various activities.

A variety of other factors can cause malnutrition. These include the coexistence of chronic diseases such as malignancy, kidney disease, liver disease, diabetes mellitus, congestive heart failure, and peptic ulcer disease. The gastrointestinal tract is vital for the digestion and absorption of nutrients. Any abnormality in the function of this organ system can lead to malnutrition (e.g., esophageal stricture, pancreatic disease, inflammatory bowel disease, short-gut syndromes following intestinal surgery, and diarrhea). Social factors such as the use of drugs, alcohol, or poverty can impair nutrient intake. Overzealous adherence to food fads, poor dentition, pregnancy, and lactation are additional risk factors for malnutrition. Iatrogenic risk factors include the administration of chemotherapy, radiotherapy, medications, and surgery.

The physical examination can provide information regarding the nutritional status of the patient. Weight loss of greater than 1.2 percent in 1 week, 5 percent in 1 month, 7.5 percent in 3 months, or 10 percent in 6 months suggests nutritional depletion. A usual weight less than 80 percent or greater than 120 percent of ideal body weight also imparts additional nutritional risk. The exam should concentrate on the gastrointestinal tract. The mouth and swallowing mechanism should be analyzed and evaluated for adequacy. Patients with disease in these organs may be incapable of adequate oral intake. The abdomen is checked for evidence of organ enlargement and

bowel function, and the rectum is examined for patency. A stool examination may reveal evidence for malabsorptive processes (e.g., liquid or fatty stool) and inflammatory involvement (e.g., bloody stool, fecal leukocytes). If gastrointestinal infection is suspected appropriate cultures, tests for ova and parasites, and toxin titers are indicated. The physical examination may reveal evidence for recent or past abdominal surgery which may predispose the patient to intestinal obstruction or may suggest short-gut syndromes. Examination of the eye grounds and neurological evaluation for neuropathy may suggest the diagnosis of diabetes mellitus. The physical examination may also provide evidence for a micronutrient deficiency (Table 1).

The clinical history and physical examination help to identify those patients who require a more detailed assessment. If both are normal then further assessment prior to initial therapy is usually unnecessary. It is important to remember that absence of obvious cachexia or a history of suboptimal nutrient intake does not always rule out significant or life-threatening malnutrition. In addition, micronutrient (e.g., vitamin, mineral), and macronutrient deficiencies can occur independently or simultaneously.

Following the clinical history and physical examination, an assessment of macronutrient status is made. This assessment encompasses an evaluation of somatic and visceral protein stores, fat stores, and immune competence (Table 2). Somatic proteins are evaluated by determining weight loss as a percent of usual body weight and ideal body weight. Percent usual body weight is calculated as (actual weight)/(usual weight) x 100 and percent ideal body weight is calculated as (actual weight)/(ideal body weight) x 100. Ideal body weight for height is determined from standard reference tables. (*1*) Weight loss is excess of 1.2 percent in 1 week, 5 percent in 1 month, 7.5 percent in 3 months, or 10 percent in 6 months suggests significant weight loss. In addition weight less than 80-90 percent of ideal body weight also contributes to nutritional impairment (Table 2).

The creatinine-height index can also provide one with an indicator of underlying muscle mass. Urine is collected for creatinine excretion and compared to standard tables.(*1*) Values less than 60-80 percent of expected levels suggest malnutrition. It is important that one realize that low levels of creatinine in a 24-hour collection of urine frequently indicate malnutrition rather than an "inadequate collection."

Somatic protein stores can also be estimated by calculation of the mid-arm muscle area (MAMA) where MAMA (square cm) = $(MAMC)^2/(4\pi)$. MAMC (mid-arm muscle circumference in square cm) = MAC - (π) (TSF)/10 where MAC is the mid-arm circumference in cm and TSF is the triceps skinfold in mm. Comparison of the MAMA to standard tables(*1*) allows for calculation of the percent MAMA and degree of malnutrition (Table 2). Fat store depletion and degree of malnutrition can be estimated by comparing the TSF to a standard table(*1*) as was done for MAMA.

Somatic protein and fat measurements may be inaccurate as a result of edema fluid retention or loss. Visceral protein levels allow one to estimate the degree of malnutrition as it relates to hepatic protein synthesis. Albumin (plasma half-life 20 days) and transferrin (plasma half-life 9 days) are the two most useful proteins measured and their levels can be used to assess the degree of malnutrition (Table 2). One must always be mindful of acute alterations in albumin which may occur following surgery and resuscitation and alterations in circulating transferrin concentrations which occur following stress (e.g., acute phase reactant).

Immune competence is evaluated by measuring the total lymphocyte count and skin reactivity to recall antigens (Table 2). Skin energy has been repeat-

TABLE 2
Assessment of Macronutrient Status

	Degree of Malnutrition		
	Mild	*Moderate*	*Severe*
Somatic Protein			
Wt (% usual)	See Text	(depends upon rate of loss)	
Wt (% ideal)	80-90	70-80	<70
Creatinine-Height Index (%)	60-80	40-60	<40
MAMA (%)	40-50	30-40	<30
Visceral Proteins			
Albumin (g/dl)	2.8-3.4	2.1-2.7	<2.1
Transferrin (mg/dl)	150-200	100-150	<100
Fat Reserves			
TSF (%)	40-50	30-40	<30
Immune Competence			
Total lymph count	1,200-2,000	800-1,200	<800
Skin tests	Reactive	Reactive	Anergic

TABLE 3
Guide to Monitoring Nutritional Status

Parameter	*Initial*	*Frequency of Measurement*
A. Global		
Electrolytes	Yes	Weekly or PRN (as needed)
Magnesium	Yes	Weekly or PRN
Calcium	Yes	Weekly or PRN
Phosphorus	Yes	Weekly or PRN
Liver function	Yes	Monthly or PRN
BUN or creatinine	Yes	Weekly or PRN
PT/PTT	Yes	Weekly or PRN
CBC	Yes	PRN
Blood glucose	Yes	Daily until stable then weekly
Triglycerides	Yes	PRN
B. Nutrient-Specific		
Albumin	Yes	Weekly
Transferrin	Yes	Weekly
Total lymph count	Yes	Weekly
24-hour urine urea nitrogen and creatinine	Yes	Weekly
Skin tests	Yes	Every 2 weeks
Weight	Yes	Daily
MAMA	Yes	Every 2 weeks
TSF	Yes	Every 2 weeks

edly associated with a high risk of infection and is a useful prognostic factor. The Prognostic Nutritional Index (PNI) has been developed to predict the risk for nutritionally-induced operative complications. The PNI (percent) is calculated as 158–16.6(ALB)–0.78(TSF)–0.2(TFN)–5.8 (DH) where ALB is the albumin concentration (g/dl), TSF is the triceps skinfold (mm), TFN is the serum transferrin concentration (mg/dl), and DH represents the maximal skin test reactivity to any of three recall antigens (e.g., streptokinase, candida, mumps). DH is zero if no reaction occurs, one if the reaction is between 0 and 5 mm, and two if the reaction is greater than or equal to 5 mm. A PNI between 40 and 50 suggests a moderate risk for complications while a value greater than 50 indicates a high risk for complications.

Total body nitrogen balance can be calculated by determining the amount of nitrogen which enters the body and the amount which exits the body (Nitrogen Balance = (Protein Intake)/6.25–UUN–4 where UUN refers to urine urea nitrogen in grams). This measurement provides an index of protein flux within the body. One strives to maintain the nitrogen balance in the 0-2 gram positive range. Values which are negative have been associated with loss of lean body mass (including cardiac muscle, skeletal muscle, and diaphragmatic muscle) as well as increased morbidity and mortality.

The nutritional parameters discussed above allow one to determine a patients degree of malnutrition and risk for complications upon entrance into the hospital and allow for monitoring the success or failure of nutritional therapy during hospitalization. Failure to improve one's nutritional parameters indicates inadequate nutritional therapy and is associated with increased morbidity and mortality. It is thus important that health care providers not only perform an initial assessment of nutritional status but also perform serial assessments. A guide to the monitoring of nutritional status is presented in Table 3. Note that we also monitor serum electrolytes, liver and renal function tests, blood sugars, coagulation parameters, and blood counts at periodic intervals.

Initial Nutritional Therapy

Following nutritional assessment of the patient, nutritional therapy should be started. We begin with a standard regimen and alter the contents when indicated by our monitoring parameters. It is important that the route of administration of nutrition be considered. The oral route is the safest, cheapest, and most physiological route for nutrient administration. If patients are unable to consume sufficient nutrients by mouth and have a functioning gastrointestinal tract, we administer our nutrients via nasogastric, gastric, or intestinal feeding tubes. When the gastrointestinal tract is not functioning properly we use the parenteral route. When diarrhea limits the amount of nutrients we can give, we may choose to administer ingredients via both enteral and parenteral routes while attempting to slowly wean the patient from parenteral therapy to enteral therapy. One should choose the most physiological route which allows for adequate delivery of nutrients.

A standard nutritional formula is listed in Table 4. We give 25-30 Kcal/Kg/day of nonprotein calories and 1.5-2.0 g/Kg/day of protein. Calculations are based upon ideal body weight and most patients require less than

2,000 Kcal per day of nonprotein calories. We divide our nonprotein calories into carbohydrate and fat calories. Carbohydrate calories are given at a rate of 3.5-6.0 g/Kg/day and fat is used to make up the remainder of the calories. However, it is desirable not to allow fat calories to exceed 30 percent of the total caloric intake per day.

Micronutrient needs must also be carefully considered so as to avoid deficiencies. These may be divided into vitamins, minerals, and trace elements. Both fat soluble (vitamin A, D, E, K) and water soluble vitamins (vitamins of the B complex group, C, biotin, and pantothenic acid) need to be included. All these (except K) are available as a unit dose solution (MVI; 10 ml) and should be given daily. Vitamin K is usually given intramuscularly as a single weekly 10 mg dose. Patients with extreme stress or large, open wounds such as burns may require additional B complex vitamins and vitamin C. There are five major minerals which are required: sodium, potassium, calcium, magnesium, and phosphorus (Table 4). Requirements vary with disease states. Patients with renal impairment have a decreased ability to excrete potassium, magnesium, and phosphorus, and these ingredients should be reduced in these patients. Standard trace element preparations include zinc, copper, chromium, and manganese. One may also wish to add iron, iodine, and selenium depending upon patient needs.

If one feeds via the enteral route and administers balanced enteral nutrition formulas, then the above requirements will usually be met provided that one gives 2,000-2,500 calories per day.

TABLE 4
Initial Nutritional Therapy

Macronutrient Requirements

1. Total nonprotein calories = 25-30 Kcal/Kg/day
2. Total protein = 1.5-2.0 g/Kg/day
3. Nonprotein calories
   - Carbohydrate = 3.5-6.0 g/Kg/day
   - Fat = Remainder of calories but no more than 30 percent

*Micronutrient Requirements**

1. Vitamins
   - All but K (MVI; 10 ml; daily)
   - Vitamin K - 10 mg weekly
2. Minerals
   - Sodium 60-150 meq/day
   - Potassium 60-100 meq/day
   - Calcium 10 meq/day
   - Magnesium 8-12 meq/day
   - Phosphorus 30-60 meq/day (10-20 mM)
3. Trace Elements
   - Zinc 2.5-4.0 mg/day
   - Copper 0.5-1.5 mg/day
   - Chromium 10-15 mcg/day
   - Manganese 0.15-0.8 mg/day
   - Iron 1-2 mg/day

*Requirements reflect body requirements and dosages need to be adjusted for gastrointestinal absorption when given by the enteral route.

Summary

Malnutrition is common in hospitalized patients. Many enter the hospital malnourished while others develop malnutrition in the hospital. Studies dealing with the effects of malnutrition have shown an increased incidence of morbidity (e.g., wound infection, sepsis, respiratory failure, prolonged hospital stay) and mortality in these patients. Recent evidence suggests that even 10 days of adequate nutritional repletion can substantially reduce the incidence of operative complications in malnourished patients (even if nutritional parameters do not return to normal). Accumulating experience also shows that adequate nutritional therapy, when given as early as possible, can reduce hospital stay, morbidity, and mortality. For these reasons, early nutritional assessment and adequate nutritional therapy are important for the optimal care of our patients.

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Courtesy Dr. Richard Helmer

Brazilian forensic anthropologist Daniel Munoz examines the Mengele skull in a São Paulo Laboratory.

Expert Witness

Diane LaMacchia

The final proof that Nazi war criminal Josef Mengele was dead came from matching a set of dental X-rays with the teeth of a skeleton Brazilian police had exhumed from a 7-year-old grave near São Paulo. The forensic scientist who made the positive identification was Lowell Levine, a captain in the U.S. Naval Reserve. Employing his expertise in forensic dentistry, CAPT Levine was able to identify the remains as belonging to the so-called "Angel of Death," who had been hiding in South America since the end of World War II.

"Mengele was a voracious keeper of diaries," Levine said. "He wrote down everything he did." Fortunately for the people tracking him, Mengele had even made a note when his regular dentist referred him to a specialist for a root canal in 1976. In a later entry in the diary, Mengele described the dentist who performed the root canal as "bald and round-faced," Levine said.

The United States Consul General in São Paulo, Stephen Dachi—coincidentally, a dentist himself—"did pretty neat detective work," said Levine. He deciphered Mengele's code word for the town where the root canal was done and located the root canal specialist—still round-faced and bald—on 21 March 1986. The Office of Special Investigations of the U.S. Justice Department called Levine and asked him to go to Brazil and take a look at the X-rays. He arrived in São Paulo on 22 March.

Levine had already flown south to Brazil once, in June 1985, as a member of a three-person team of forensic scientists from the U.S. Marshal Service. Along with another team from the Simon Weisenthal Foundation (a private Los Angeles-based organization dedicated to apprehending Nazi war criminals), the Justice Department experts had concluded with "reasonable scientific certainty" that the remains of a man who had drowned in 1979 at a beach near São Paulo were indeed those of Josef Mengele.

On Levine's second visit, he was left with no doubt of the skeleton's identity. There were eight dental X-rays taken of Mengele by the root canal specialist. Any one of the eight gave a positive identification of the skeleton, Levine pointed out.

Career in Forensic Science Began in the Navy

CAPT Lowell Levine, DC, USNR, was commissioned in the Navy as an ensign while a student at New York University Dental School under the Ensign 1925 Program. He served on active duty from 1963 to 1965 and has been in the Naval Reserve ever since. Currently, he is the Commanding Officer of the 14th Dental Company, 4th Force Service Support Group, drilling in Philadelphia, PA.

He got involved in forensic odontology, or forensic dentistry, "by accident," Levine said. While on active duty, he attended several lectures on forensic dentistry. Then as a reservist in the mid-1960's, he took a short course in forensic dentistry at the

Dr. Levine presents final report on Mengele's identification.

The Washington Post

FINAL

SATURDAY, JUNE 22, 1985

U.S. Seeks to Cool Hopes For Hostages' Early Release

Peres Moves to Avoid Rift

Outside Mediators Restricted

Experts Say Remains Are Mengele's

Decision Made 'Within a Reasonable Scientific Certainty'

Anti-U.S. Protest

Militant Shiite Moslems March on Beirut Airport

Diane LaMacchia is deputy public affairs officer at the Naval Medical Command (MEDCOM 00D4-1), Washington, DC 20372-5120.

Armed Forces Institute of Pathology. Some time later, the dean of the New York University Dental School, where Levine was a part-time faculty member, was approached by the New York City Chief Medical Examiner for help on a case. The dean remembered Levine had some familiarity with forensic dentistry and put the examiner in touch with him. "I got the answers right," Levine said, laughing, and from then on, the New York City official consulted him regularly.

Forensic science—the use of scientific evidence in the justice system—employs a team approach. Forensic odontologists combine their expertise with scientists in other fields to arrive at a conclusion. As an example, Levine outlined the way "scientific certainty" was arrived at in the Mengele case.

Forensic anthropologists established that the skeleton's race, height, sex, and age corresponded to information contained in Josef Mengele's 1938 SS personnel files captured by the U.S. Army after World War II. The anthropologists also superimposed pictures of the skull over photographs from the personnel files and other photographs, allegedly taken of Mengele while he lived in South America, and observed that all the photos matched. Forensic pathologists helped the anthropologists examine the remains and interviewed some witnesses. A forensic radiologist examined the skeleton for various disease processes and healed injuries which might tie in with what was known of Mengele's personal history. Levine and the other dentists did a clinical and X-ray examination of the skeleton's teeth and jaw and found that the fillings and extractions did not contradict their knowledge of Mengele's dental work. Handwriting experts compared the writing in the diaries, in letters, and on the backs of photos with handwriting samples from Mengele's SS file. They positively identified that the writing was all done by the same person.

Each of the forensic scientists examined the evidence and arrived at independent conclusions. Then they got together, compared notes, and found that their conclusions were the same. This process provided the team with the scientific certainty that what they were looking at were indeed the remains of Josef Mengele.

Courtesy Dr. Richard Helmer

The video imaging process known as skull-face superimposition was just one of the tools used to help identify Josef Mengele. Here two 47-year-old photos are blended with photo images of the skull suspected to be that of the notorious "Angel of Death." The white dots or markers on the skull exactly match the photos' facial contours.

Forensic Expertise in Demand Worldwide

Levine's work, both as a civilian forensic consultant and as a naval reservist, takes him all over the world. In April of this year he served his 2 weeks of Active Duty for Training (ACDUTRA) at the United States Army Central Identification Laboratory, HI (CILHI), as part of an Army/Navy task group set up to create a data base for the laboratory's computer.

In December 1985 Levine and two forensic anthropologists had been asked by the Department of Defense to review the laboratory's operation. Their report, which the Army made public in February 1986, indicated an extensive backlog of dental records on service members missing in action in Vietnam. CILHI had the MIA's dental records, but about 2,000 of them had not been analyzed and entered into the data base for the lab's computer matching program.

In April CAPT Levine, two other Navy officers (CAPT B.F. Dattilo, DC, USNR, and CDR Edward Lally, DC, USNR), and several Army dental officers got together and went over each record, line by line, "literally following the dental status of each tooth," Levine said, "from the beginning of the member's career in the military. Some of the records reflected military dental treatment for a period of more than 20 years. The team then reconciled the written notations in the records with whatever X-rays of sketches existed. This way we could determine what the teeth and jaws of each MIA looked like when they became MIA," Levine continued. All the information was then entered into the computer data base.

Now when the skeleton of someone missing in action is obtained, the examiner can enter into the computer information on whatever dental restorations had been made, Levine pointed out, and the "computer will search through the data base and suggest all those people in there who could possibly be consistent with your findings.

"Instead of looking through 2,400 charts, [the computer] narrows it down to probably just a few," Levine said. "Then you get those charts physi-

cally out, examine them and literally compare X-ray films, if you have them, X-ray against X-ray to be able to make a positive comparison." Or the dental records may contain enough sketches of what the fillings looked like to make a positive identification.

As a result of work he and the task group did during his latest ACDUTRA, the CILHI now has a good data base on all existing dental records for the remaining MIA's. This was a worthwhile undertaking, because, for skeletonized remains, "the easiest and most rapid method of identification is dental," Levine said. "One dental X-ray is as good as a fingerprint."

Identification of Argentina's "Disappeared"

As a civilian, Levine is consulted by agencies and governments all over the world. He has been to Argentina twice to set up a scheme for the exhumation, identification, and determination of the cause and manner of death of the "desaparecidos." These are the estimated 9,000 people who disappeared in Argentina between 1976 and 1983, allegedly murdered by the military regime then in power.

His first trip to Argentina was with a group of forensic scientists sponsored by the American Association for the Advancement of Science (AAAS). They were the first outsiders to visit Argentina after the fall of the military dictatorship and arrived as guests of the National Commission on the Disappeared. The group examined clandestine detention centers and went through quantities of skeletal material uncovered in mass graves and unmarked graves throughout the countryside. One of the dead they helped to identify was a 23-year-old girl, Cristina Costanzo, who allegedly had been tortured, interrogated, and shot to death by police intelligence. The positive identification of Costanzo was used as evidence in the trial of the members of the three military juntas which had ruled Argentina, according to Eric Stover of the AAAS, who accompanied Levine's group and later testified at the trial.

In March 1985 Levine returned to Argentina at the invitation of the Alfonsin government. This time his job was to train forensic scientists to continue the work of identifying the "desaparecidos." The country's already-trained forensic scientists had "no credibility with family and friends and human rights groups," Levine said, "because they had worked under the regime of the generals." Levine trained an entirely new group, untainted by former association with the deposed government.

Levine has also worked on famous cases in the United States. He was one of the forensic consultants to the Select Committee on Assassinations, a House committee which met in 1977 and 1978 to reinvestigate the assassination of President Kennedy. Levine identified X-rays allegedly taken during the autopsy at the Bethesda Naval Hospital and concluded that "they were, in fact, taken on Kennedy."

In the past year Philadelphia's special commission investigating the MOVE confrontation asked for Levine's help. The Philadelphia medical examiner's office had been unable to identify all the people killed when the city dropped a bomb on the row house where the radical group was headquartered. Levine and a team of forensic scientists were able to identify them "with reasonable scientific certainty."

Levine has also investigated a number of commercial airline incidents, including the 1979 crash of a DC-10 taking off from Chicago's O'Hare Airport. All 274 people on board were killed in the largest fatal accident in U.S. history. With a team of other dentists, he identified about 200 of the victims. The others were identified by fingerprints, medical X-rays, and skeletal X-rays.

Levine, 48, lives in Huntington Station, NY, where he also has his consulting firm. From 1968 to 1980 he was a consultant to the New York City

Life *magazine featured Dr. Levine (left) and other members of the investigative team in one of its recent issues.*

Medical Examiner. Currently he is consulted by Nassau County, NY, and by various agencies throughout the United States and overseas. He also teaches the latest techniques in forensic dentistry. In December 1984 he was one of the faculty in a course co-sponsored by the Institute of Legal Medicine and the FCOP, a federation of all the Central American dental societies. The course was given in San Jose, Costa Rica, and attended by about 250 forensic scientists from Central America, including two Sandinistas from Nicaragua.

New York Special Forensic Unit

One of Levine's latest accomplishments was the founding—along with Governor Mario Cuomo, Criminal Justice Director Lawrence Kurlander, and State Police Superintendent Donald Chesworth—of the New York State Police Forensic Consultation Unit. Levine is very proud of the unit of forensic scientists which, he says, is the first of its kind in the United States. "Governor Cuomo has been super-supportive of the scientific approach to crime detection," Levine said, the New York police have "put together some spectacular cases that would have been lost if not for this unit."

The unit is composed of a dozen board-certified doctoral level forensic scientists throughout the state who can come, Levine said, "within 2 hours to look at any case anywhere in the state." The police also have established other resources who are not actually members of the unit. These resources include experts in forensic pathology, dentistry, anthropology, photogrammetry (dealing with aerial photos and image enhancements), nuclear medicine, behavioral science, and entymology. The unit has also trained all 800 members of the New York Bureau of Criminal Investigation in the latest technology in forensic science and has trained various police agencies to document and recognize evidence.

Navy Dental Officer Training Invaluable

Levine said his Navy career has been invaluable to him in his work in forensic dentistry. Because "all the sailors and marines you're treating have the potential of being in harm's way an hour after you're treating them," Levine said, a dentist in the Navy—where there is always a real possibility of casualties—develops a much greater awareness of the importance of comparisons and record-keeping, key components of forensic odontology. "It trains you to be much more meticulous in your record-keeping."

Levine also benefited from the greater exposure a Navy dentist gets to various kinds of dental treatments—experience useful for a forensic scientist. Looking into the mouths of Navy men and women, "you get to see dental work from all over the U.S.," he pointed out.

Levine's success as a forensic odontologist is due in part to the leadership training he received early in his Navy career. "The leadership training you get as a junior naval officer puts you about two dozen steps above anyone else in dealing with any civilian job," Levine insisted.

"As a naval officer you learn very quickly to express yourself both verbally and in writing. In the forensic sciences, you're spending a considerable amount of time explaining your interpretation of the dental evidence as an expert witness. So it's really crucial that you express yourself with poise and firmness—skills one learns as an officer," Levine said. He plans to stay in the Naval Reserve as long as he feels he can make a meaningful contribution.

Meanwhile, in New York State, he is involved in promoting the use of forensic science in the investigation of crimes against living victims and in training lay people to collect and document evidence. "In many areas of the world, the investigation of injuries by criminals to living victims is important," Levine said. But in the United States, crimes in which the victim dies are usually more thoroughly investigated. And normally the "people who see the victims are doctors and nurses who are trying to save lives, not collect evidence." CAPT Levine emphasized that training these people to collect and document evidence on victims of violent crimes will very much improve the criminal justice system "so that the violent criminals can be taken off the streets." □

Photo by the Editor

Dr. Levine at work in the Nassau County, NY, medical examiner's office.

"Doc" Lipes Commandeers a Submarine Officers' Wardroom

George Weller

Somewhere in Australia—"They are giving him ether now," was what they said back in the aft torpedo rooms.

"He's gone under, and they're ready to cut him open," the crew whispered, sitting on their pipe bunks cramped between torpedoes.

One man went forward and put his arm quietly around the shoulder of another man who was handling the bow diving planes.

"Keep her steady, Jake," he said. "They've just made the first cut. They're feeling around for it now."

"They" were a little group of anxious-faced men with their arms thrust into reversed white pajama coats. Gauze bandages hid all their expressions except the tensity in their eyes.

"It" was an acute appendix inside Dean Rector of Chautauqua, Kansas. The stabbing pains had become unendurable the day before, which was Rector's first birthday at sea. He was nineteen years old.

The big depth gauge that looks like a factory clock and stands beside the "Christmas tree" of red and green gauges regulating the flooding chambers showed where they were. They were below the surface. And above them were enemy waters crossed and recrossed by whirring propellers of Japanese destroyers and transports.

The nearest naval surgeon competent to operate on the nineteen-year-old seaman was thousands of miles and many days away. There was just one way to prevent the appendix from bursting, and that was for the crew to operate upon their shipmate themselves.

And that's what they did; they operated upon him. It was probably one of the largest operations in number of participants that ever occurred.

"He says he's ready to take his chance," the gobs whispered from bulkhead to bulkhead.

"That guy's regular"—the word traveled from bow planes to propeller and back again.

They "kept her steady."

The chief surgeon was a twenty-three-year-old pharmacist's mate wearing a blue blouse with white-taped collar and squashy white duck cap. His name was Wheeler B. Lipes. He came from Newcastle near Roanoke, Virginia, and had taken the Navy hospital course in San Diego, thereafter serving three years in the naval hospital at Philadelphia, where his wife lives.

Lipes' specialty as laboratory technician was in operating a machine that registers heartbeats. He was classified as an electrocardiographer. But he had seen Navy doctors take out one or two appendixes and thought he could do it. Under the sea, he was given his first chance to operate.

There was difficulty about the ether. When below the surface the pressure inside a boat is above the atmospheric pressure. More ether is absorbed under pressure. The submariners did not know how long their operation would last.

They did not know how long it would take to find the appendix. They did not know whether there would be enough ether to keep the patient under throughout the operation.

They didn't want the patient waking up before they were finished.

They decided to operate on the table in the officers' wardroom. In the newest and roomiest American submarine the wardroom is approximately the size of a Pullman-car drawing room. It is flanked by bench seats attached to the wall, and a table occupies the whole room—you enter with knees already crooked to sit down. The only way anyone can be upright in the wardrooms is by kneeling.

The operating room was just long enough so that the patient's head and feet reached the two ends without hanging over.

First they got out a medical book and read up on the appendix, while Rector, his face pale with pain, lay in the narrow bunk. It was probably the most democratic surgical operation ever performed. Everybody from boxplane man to the cook in the galley knew his role.

The cook provided the ether mask. It was an inverted tea strainer. They covered it with gauze.

The twenty-three-year-old "surgeon" had, as his staff of fellow "physicians," all men his senior in age and rank. His anesthetist was Communi-

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For this story, George Weller, reporter for the *Chicago Daily News*, was awarded the Pulitzer Prize for distinguished reporting in 1942. Reprinted from the *Chicago Daily News*, December 14, 1942.

cations Officer Lieutenant Franz Hoskins of Tacoma, Washington.

Before they carried Rector to the wardroom, the submarine Captain, Lieutenant Commander W.B. Ferrall of Pittsburgh, asked Lipes as the "surgeon" to have a talk with the patient.

"Look, Dean, I never did anything like this before," Lipes said. "You don't have much chance to pull through, anyhow. What do you say?"

"I know just how it is, Doc."

It was the first time in his life that anybody had called Lipes "Doc." But there was in him, added to the steadiness that goes with a submariner's profession, a new calmness.

The operating staff adjusted gauze masks while members of the engineroom crew pulled tight their reversed pajama coats over their extended arms. The tools were laid out. They were far from perfect or complete for a major operation. The scalpel has no handle.

But submariners are used to "rigging" things. The medicine chest had plenty of hemostats, which are small pincers used for closing blood vessels. The machinist "rigged" a handle for the scalpel from a hemostat.

When you are going to have an operation, you must have some kind of antiseptic agent. Rummaging in the medicine chest, they found sulfanilamide tablets and ground them to powder. One thing was lacking: there was no means of holding open the wound after the incision had been made. Surgical tools used for this are called "muscular retractors." What would they use for retractors? There was nothing in the medicine chest that gave the answer, so they went as usual to the cook's galley.

In the galley they found tablespoons made of Monel metal. They bent these at right angles and had their retractors.

Sterilizers? They went to one of the greasy copper-colored torpedoes waiting beside the tubes. They milked alcohol from the torpedo mechanism and used it as well as boiling water.

The light in the wardroom seemed insufficient; operating rooms always have big lamps. So they brought one of the big floods used for night loadings and rigged it inside the wardroom's sloping ceiling.

The moment for the operation had come. Rector, very pale and stripped, stretched himself out on the wardroom table under the glare of the lamps.

Rubber gloves dipped in torpedo alcohol were drawn upon the youthful "Doc's" hands. The fingers were too long. The rubber ends dribbled limply over.

"You look like Mickey Mouse, Doc," said one onlooker.

Lipes grinned behind the gauze.

Rector on the wardroom table wet his lips, glancing a side look at the tea-strainer ether mask.

With his superior officers as his subordinates, Lipes looked into their eyes, nodded, and Hoskins put the tea mask down over Rector's face. No words were spoken; Hoskins already knew from the look that he should watch Rector's eye pupils dilate.

The twenty-three-year-old surgeon, following the ancient hand rule, put his little finger on Rector's subsiding umbilicus, his thumb on the point of the hipbone, and, by dropping his index finger straight down, found the point where he intended to cut. At his side stood Lieutenant Norvell Ward of Indian Head, Maryland, who was his assistant surgeon.

"I chose him for his coolness and dependability," said the Doc afterward of his superior officer. "He acted as my third and fourth hands."

Lieutenant Ward's job was to place tablespoons in Rector's side as Lipes cut through successive layers of muscles.

Engineering Officer Lieutenant S. Manning of Cheraw, South Carolina, took the job which in a normal operating room is known as "circulating nurse." His job was to see that packets of sterile dressings kept coming and that the torpedo alcohol and boiling water arrived regularly from the galley.

They had what is called an "instrument passer" in Chief Yeoman H.F. Wieg of Sheldon, North Dakota, whose job was to keep the tablespoons coming and coming clean. Submarine Skipper Ferrall too had his part. They made him "recorder." It was his job to keep count of the sponges that went into Rector. A double count of the tablespoons used as retractors was kept: one by the Skipper and one by the cook, who was himself passing them out from the galley.

It took Lipes in his flap-finger rubber gloves nearly twenty minutes to find the appendix.

"I have tried one side of the caecum," he whispered after the first minutes. "Now, I'm trying the other."

Whispered bulletins seeped back into the engine room and the crews' quarters.

"The Doc has tried one side of something and now is trying the other side."

After more search, Lipes finally whispered, "I think I've got it. It's curled way into the blind gut."

Lipes was using the classical McBurney's incision. Now was the time when his shipmate's life was completely in his hands.

"Two more spoons." They passed the word to Lieutenant Ward.

"Two spoons at 14.45 hours [2:45 p.m.]," wrote Skipper Ferrall on his note pad.

"More flashlights. And another battle lantern," demanded Lipes.

The patient's face, lathered with white petrolatum, began to grimace.

"Give him more ether," ordered the Doc.

Hoskins looked doubtfully at the original five pounds of ether now shrunk to hardly three quarters of one can, but once again the tea strainer was soaked in ether. The fumes mounted up, thickening the wardroom air and making the operating staff giddy.

"Want those blowers speeded up?" the Captain asked the Doc.

The blowers began to whir louder.

Suddenly came the moment when the Doc reached out his hand, pointing toward the needle threaded with twenty-day chromic catgut.

One by one the sponges came out. One by one the tablespoons bent into right angles were withdrawn and returned to the galley. At the end it was

the skipper who nudged Lipes and pointed to the tally of bent tablespoons. One was missing. Lipes reaches into the incision for the last time and withdrew the wishboned spoon and closed the incision.

They even had the tool ready to cut off the thread. It was a pair of fingernail scissors, well scalded in water and torpedo juice.

At that moment the last can of ether went dry. They lifted up Rector and carried him into the bunk of Lieutenant Charles K. Miller of Williamsport, Pennsylvania. Lieutenant Miller alone had had control of the ship as diving officer during the operation.

It was half an hour after the last tablespoon had been withdrawn that Rector opened his eyes. His first words were, "I'm still in there pitching."

By that time the sweat-drenched officers were hanging up their pajamas to dry. It had taken the amateurs about two and a half hours for an operation ordinarily requiring forty-five minutes.

"It wasn't one of those 'snappy valve' appendixes," murmured Lipes apologetically as he felt the first handclasps upon his shoulders.

Within a few hours, the bow and stern planesmen, who, under Lieutenant Miller's direction, had kept the submarine from varying more than half a degree vertically in 150 minutes below the stormy sea, came around to receive Rector's winks of thanks. Rector's only remark was, "Gee, I wish Earl was here to see this job." His brother Earl, a seaman on the Navy submarine tender *Pigeon,* is among the list of missing at Corregidor, probably captured.

When the submarine surfaced that night, the ether-drunk submarine crewmen found themselves grabbing the sides of the conning tower and swaying unsteadily on their feet. Thirteen days later Rector, fully recovered, was at his battle station, manning the phones. In a bottle vibrating on the submarine's shelves was the prize exhibit of surgeon Lipes—the first appendix ever known to have been removed below enemy waters. □

Navy's Occupational Health Information Management System

LCDR James C. Helmkamp, MSC, USN

Historically, epidemiological research has focused on disease and the description of disease occurrence in terms of person, place, and time-related variables. Recently, however, the emphasis has shifted to the study of exposed rather than diseased persons. The long-term effects of exposure to a substance are clearly as important as the antecedents of a particular disease. Persons working in Navy industrial environments have daily contact with large numbers of chemical, physical, or biological exposures. Some of these exposures are known to cause disease in humans, others have been shown to be harmful to animals in varying doses, and others have no known adverse health effects.

Objectives of NOHIMS

The Navy's Occupational Health Information Management System (NOHIMS) is an information system that enables the occupational safety and health program to meet the requirements of the OSHA Act of 1970 and Navy directives(*1,2*) in developing a comprehensive workplace monitoring plan and personnel medical surveillance program.(*3,4*)

To meet these goals, the objectives of NOHIMS are to:

- identify individuals exposed to hazards in the workplace,
- insure that potential exposed persons are examined periodically,
- provide medical personnel with exposure histories and a list of recommended tests and procedures,
- store and retrieve medical and environmental data,
- generate management reports, and
- insure the recording of sufficient information for epidemiological studies.

Figure 1 indicates three types of data that have been identified to help satisfy these objectives: (1) *Environmental Data*—workplace environments, hazards identification, survey data; (2) *Personnel Data*—occupational histories, demographic information, worker identification and location; and (3) *Medical Data*—medical histories, physical exams, and laboratory tests.

These types of raw data must be entered into the system on an ongoing basis. Reference tables (job titles, Threshold Limit Values, required medical surveillance information, etc.) have been developed from authoritative sources. They make it possible to interpret and evaluate the significance of a particular element of data and provide an aid in recommending appropriate action. The tables are dynamic because they can be modified to reflect any changes in recognized

Dr. Helmkamp is a research epidemiologist assigned to the Occupational Medicine Department, Naval Health Research Center, San Diego, CA 92138-9174.

standards or to add entirely new categories of data.

As shown in the middle panel of Figure 1, NOHIMS consists of two principal subsystems: (1) a *Medical Component* and (2) an *Occupational Health Information Component*. The medical component provides the user with a choice of 11 primary modular options. Within the *Enter Medical Data* module, the Medical History Form(*5*) requests information on past individual and family medical history, personal history including questions on smoking, alcohol consumption, and exercise habits, and a comprehensive review of body and organ systems. Epidemiological data relating to exposures that tend to occur either through individual behavior or cultural habits, such as smoking, drug use, and diet may be important secondary or modifying variables that could contribute to a better understanding of disease process and etiology. The last primary system option takes the user to the second level menu occupational component. This component contains six module options, several of which will provide important background epidemiological and baseline occupational information as explained below.

One of the most critical elements in any occupational health information system is the ability to track individuals through their exposure experiences in order to build as accurate and complete an exposure history as possible. Within *Personnel Data* module, the Occupational History Form(*5*) is designed to ascertain an individual's occupational and nonoccupational exposures for all jobs held since high school. Such exposure histories are needed in the individual case to infer possible etiology as a basis for treatment and at the group level to support epidemiologic investigations of suspected health hazards.

The *Survey Data* module handles all information about work environments collected by industrial hygienists, including specific chemicals or agents present, methods of measurement, concentrations, usage rates, and protective equipment.

The *Hazard Data* module manages entry, storage, and retrieval of information about potentially hazardous substances that are used at the facility, including Threshold Limit Values, exposure limits, and medical monitoring requirements for each agent.

NOHIMS as a Source of Epidemiologic Data

Ascertaining an individual's previous medical and occupational experience histories requires a full understanding of a worker's current health status and the potential impact on health risk and future job performance. Cogent and timely use of such information would contribute to more informed medical and administrative decisionmaking for job placement and health risk.

The extensive cross-referencing feature of NOHIMS is one of the major characteristics of the system that assures maximum flexibility and adaptability. The NOHIMS file structure provides pointers from one type of data element to another so that it is possible to track workers by social security number through their entire work history and medical encounters. Thus, it is possible to retrieve data from all environments in which an employee has worked, the time spent in each, hazards existing in these environments, protective gear used, levels of exposure to hazardous substances, required medical surveillance, plus the medical history and results of physical exams and laboratory tests.

NOHIMS will facilitate the requirement for the maintenance of records and health information for some exposures for a specified period of time,(*1*) e.g., asbestos environmental and personnel air sampling records, X-ray interpretations, films—50 years following termination of service or employment, audiograms—40 years after the date of last entry. Thus, NOHIMS will provide epidemiologists the means to define cohorts of industrial populations and to evaluate any adverse health effects retrospectively, cross-sectionally, or prospectively.

The potential epidemiologic research applications from the NOHIMS data base will be numerous. Questions that might be addressed include the following:

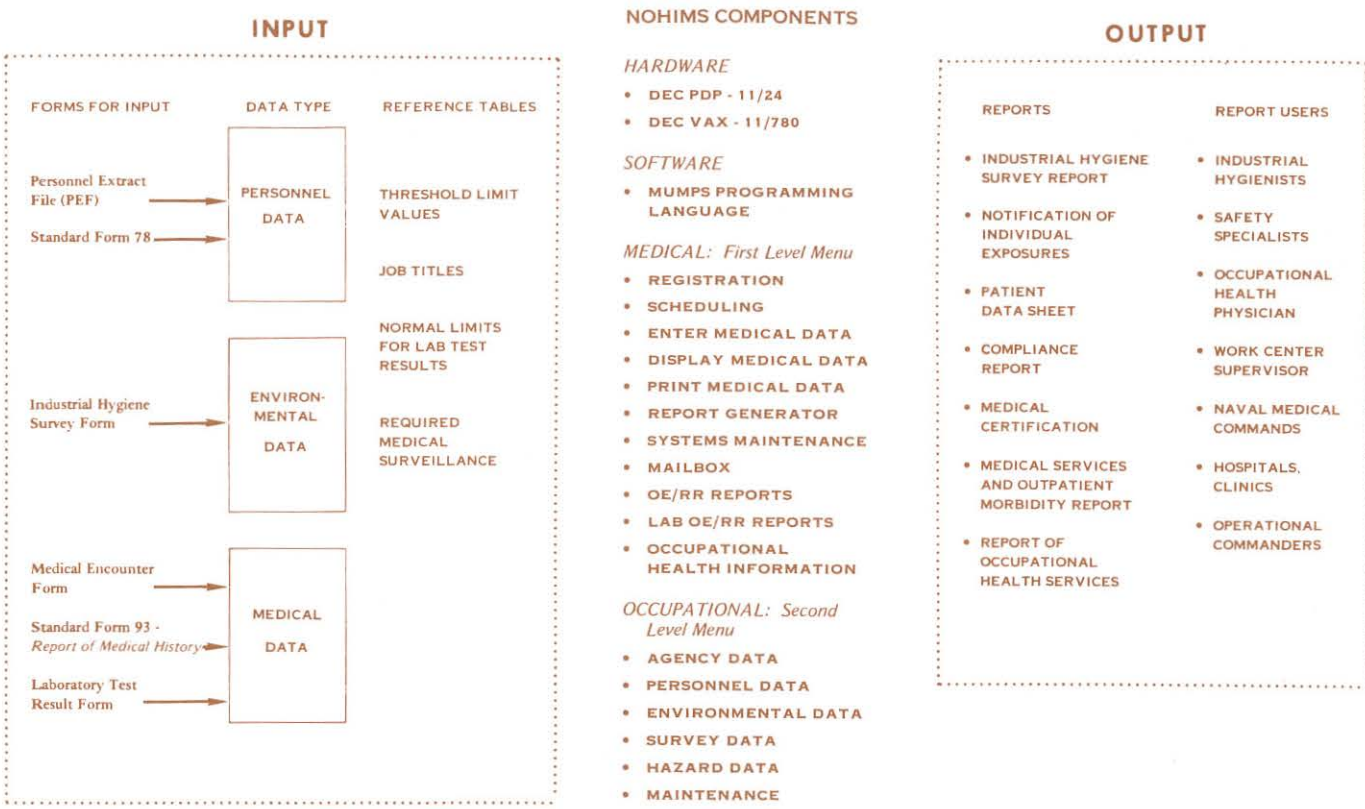
- What is the population-at-risk that is potentially exposed to a particular hazardous agent?
- Of those workers exposed, in what work environment were they exposed, at what levels of exposure, at what time, and for how long?
- What are the medical effects of this exposure and what organ systems or body parts are affected?
- Among those workers exposed, who received required physical examinations and was appropriate personal protective equipment provided?
- Do the exposed workers have common risk factors that are not present in the rest of the population-at-risk?

Two epidemiologic investigations recently completed at the Naval Health Research Center (NHRC) utilized computerized medical data resources at NHRC.(*6,7*) In the first of these studies,(*6*) it was hypothesized that occupational, social, and medical factors may contribute to an increased risk of Hodgkin's disease in naval personnel as compared to the general population, and that the risk may vary by occupation and length of service. The second study(*7*) was undertaken to assess whether excess morbidity and mortality would be found in Navy occupational groups potentially exposed to the torpedo propellant Otto Fuel II.

These investigations utilized data files that provided medical and personal information and only indirect exposure information by inference from occupational codes. The lack of exposure data in these data bases points out a significant design feature of NOHIMS that will provide comprehensive survey and medical surveillance information in addition to medical and personal data.

Potential Limitations

Automated information systems such as NOHIMS augment the efficient collection, processing, and stor-



INPUT - OUTPUT INTERFACE IN NOHIMS

Figure 1

age of voluminous data on human populations. Because health researchers may have ready access to data collected by others and perform instant analysis, inherent system data collection weaknesses may not be as readily apparent to the user. Therefore, there is a continual need for careful analysis and cautious interpretation of epidemiologic data.

In the final analysis, one must keep in mind that the ultimate goal of NOHIMS is to contribute to a safe and healthful working environment for all workers, and that a reasonable balance must be struck between scientific objectives and practical considerations of system application.

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Body Fat as an Indicator of Performance of Physical Fitness Testing

LCDR David O. Parrish, MC, USNR
LT Marie F. Gustin, MSC, USN

Physical fitness is an important part of Navy life and an increased emphasis is being placed on the physical fitness test (PFT) and evaluations. Failure can result in corrective action and possible discharge from the service. The purpose of this study was to determine if body fat alone is a reliable indicator for performance on the PFT. If this is true, many man-hours could be saved and possible ill effects avoided, such as needless injuries due to poor conditioning. The need for medical examination prior to vigorous exertion, especially in those over 40 years of age, is well documented.(*1*) For example, isometric contractions which occur during sit-ups have been known to cause significant increase in blood pressure that could be detrimental to an older person.(*2*)

The intensity, frequency, and duration of exercise are important variables in improving cardiovascular status. Current research tends to indicate that cardiovascular fitness requires a minimum of 1 hour to 1½ hours of sustained exercising every other day.(*3*) Inactivity affects strength, power, muscular and cardiovascular endurance, speed, agility, and flexibility, having the opposite effect of increased physical activity. Inactivity also causes an increase in total body fat. Cardiovascular endurance capacity is lost very rapidly when regular exercise is stopped. Inactivity causes lesser effects on strength, power, muscular endurance, speed, agility, and flexibility. Flexibility is lost quickly but can be reattained in a relatively short time. Strength, power, and muscular endurance have been shown to be retained in the trained individual up to 6 weeks. Fifty percent of the strength gained will be retained for up to 1 year after cessation of training.(*4*)

Physical fitness has become of increasing importance to all Americans. The role of diet and regular exercise for the preventive treatment of heart disease is well documented. "Motor fitness" is often used synonymously with "physical fitness" and involves such elements as power, agility, speed, and balance. Also, physical fitness is sometimes defined in terms of the capacity to do work. There is, therefore, a lack of agreement on the components of physical fitness and as might be suspected, some physical educators feel that items involving skill and ability should not be included. B.L. Johnson and J.K. Nelson measure physical fitness based on the following components: flexibility, strength, muscular endurance, cardiovascular endurance, anthropometric measurements, body build, and body composition. There are no standardized test batteries made up solely of these components.(*5*)

The physical fitness test used in our study was: (1) The sit and reach, a measure of flexibility; (2) The 1.5-mile run, a measure of cardiovascular fitness; and (3) The sit-up, a measure of muscular endurance. The sit and reach measures the development of flexion at the hip and lower back and extension of the hamstring muscles. Flexibility does not exist as a general condition and a person may be flexible in one joint, average in another joint, and tight in a third.(*6*) It is commonly observed that most runners have very tight hamstring muscles. Cardiovascular fitness was measured by the 1.5-mile run. An alternative to this is the Harvard step-test which takes 5 minutes and measures physical fitness for muscular work and the ability to recover from work. A graduated exercise tolerance test is the most objective and safe determination of cardiovascular fitness. Muscular endurance was measured with the sit-up. The push-up, chin-up, and flexed arm hand are also sometimes used as muscular endurance tests. These tests can indicate an individual's preparedness for vigorous activity. The bent-knee sit-up specifically measures the endurance of the abdominal muscles. The other tests measure the endurance of the arms and shoulder girdle. General muscular endurance of the body can also be

When this article was written Dr. Parrish was chairman of the Department of Family Practice at U.S. Naval Hospital, Guantanamo Bay, Cuba. LT Gustin was chief, Physical Therapy Department, Naval Hospital, Pensacola, FL. She is also in private practice in Pensacola.

measured with the squat-thrust, also known as the Burpee test. Motivation and increased relative strength both enhance the results of endurance testing.

Our study also measured body fat percentage. B.L. Johnson and J.K. Nelson state that below 15 percent body fat in men and 19 percent body fat in women is excellent. Likewise greater than 25 percent body fat in men and greater than 31 percent body fat in women is very poor. The circumferential measurements we used show a 3-5 percent error factor. Percent of body fat is most accurately measured hydrostatically by emersion in water. This uses the Archimedian principle whereby the volume of a body is determined from its displacement of water.

Methods

Subjects in this study included 350 male and female naval personnel, age 18 to 56 years, stationed at Naval Hospital, Pensacola, FL, in April 1983. Medically excused individuals were eliminated from the study. All personnel were tested between 21 and 25 March 1983 and on 15 April 1983. Testing was performed by the Physical Therapy Clinic personnel according to Navy instruction guidelines. Stopwatches were used for the 1.5-mile run and sit-ups. The same clinic balance scale was used for the height and weight measurements. Body circumference measurements were done with tape measures. The 1.5-mile run was performed on a 1.5-mile course near the hospital. It was performed last, preceded by the 2-minute timed sit-ups and the sit and reach. Circumferential body measurements for males and females as well as height and weight were measured prior to testing. Using OPNAVINST 6110.1B testing results for each portion of the PFT were scored in terms of outstanding (5), excellent (4), good (3), satisfactory (2), and minimum standard (1). In this study "fail" (0) signified below minimum standards. For simplicity as to statistical treatment, age categories were less than 25 years, 25-34 years, 35-44 years, and greater than 45 years.

TABLE 1
Correlation of OCPERF* by Age Group to Each PFT Category

	Body Fat	1.5-Mile Run	Sit-ups	Sit and Reach
< 25 years (n=124)	0.74	0.83	0.57	0.54
25-34 years (n=162)	0.77	0.73	0.55	0.56
35-44 years (n=50)	0.85	0.67	0.67	0.65
> 44 years (n=14)	0.78 $p<0.001$	0.56 $p<0.04$	0.50 $p<0.07$	0.64 $p<0.01$
All age groups Total (n=350)	0.78	0.73	0.59	0.58

All above correlation coefficient (r) were $p<0.0001$, except as indicated for >44 years.
*OCPERF = overall calculated performance

Results

Results of the PFT are presented in Table 1. Data was treated statistically using chi-square technique to test the null hypothesis that no correlation existed between body fat and the overall calculated performance on the PFT. A calculated performance was arbitrarily chosen by the authors in order to statistically treat the data. Weights were assigned as follows: "3" to body fat and the 1.5-mile run and "2" to the sit-up and sit and reach test.

The authors felt that cardiovascular status and body fat were more important than flexibility of the lower spine and abdominal musculature endurance. Results show that the overall calculated performance was highly correlated with body fat with a correlation coefficient of 0.78 ($p<0.0001$, n=350). The sit-ups and run had a good correlation with the overall calculated performance, however, not as high as with body fat. Sit and reach had a low correlation with the overall calculated performance. The actual correlation and coefficients can be noted in Table 1. In the age group less than 25 years (n=124), the run had the highest correlation with the overall calculated performance ($r=0.83$, $p<0.0001$). The body fat correlation was r=0.74. In the age group 25-34 years (n=162) body fat was highest with a correlation coefficient of r=0.77, the run was second (r=0.73). In the age group 35-44 years (n=50) body fat was highest with a correlation coefficient of r=0.85. In the age group above 44 years (n=14) the body fat was highest at r=0.78; however, the small sample size may have invalidated that particular segment.

Discussion

The Navy as well as other branches of the military are constantly concerned about physical readiness. To address this concern, the PFT's were given to assess physical readiness as described in this paper. Statistical treatment of the results indicate that there is a high correlation of body fat to overall calculated performance on

the PFT. The table shows these correlations. The importance of this correlation indicates that the test of body fat is an important indicator of physical readiness and could be used in lieu of time-consuming PFT's. This simple measurement could alert commands of those not likely to measure up to the standards of physical readiness. There was also a high correlation with the 1.5-mile run but not as high as with body fat. This finding seems logical with what we know about sedentary lifestyle associated with body fat increase and poor physical conditioning.

Summary

This study explored the results of the 1983 PFT's according to the new OPNAVINST 6110.1B. Three hundred and fifty naval personnel, male and female between 18 and 56 years of age were tested at the Naval Hospital, Pensacola, FL, in the spring of 1983. The null hypothesis that no correlation existed between body fat and the overall calculated performance on the PFT was rejected as statistical treatment revealed a very high correlation coefficient of $r=0.74$ ($p < 0.0001$) in the age group less than 25 years, $r=0.77$ ($p < 0.0001$) in the age group 25 to 34 years, and $r=0.85$ ($p < 0.0001$) in age group 35-44 years, and $r=0.78$ ($p < 0.001$) in the age group greater than 44 years. This study suggests that body fat criteria alone could be used as the screening method to determine potential physical readiness or more importantly to select those likely not to measure up to physical readiness. This would save time and money in producing comparable results and maintaining physical readiness for the military.

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Free Breast Self-Examination Kit Available

When talking about a problem as serious as breast cancer, is it possible to say things are getting better just because something else is worse? Not according to the American Institute for Cancer Research (AICR), which has announced free distribution of a special reminder and instruction sticker package on breast self-examination.

"Since current estimates indicate that lung cancer will, in 1986, replace breast cancer as the leading cancer killer of women, some women have mistakenly assumed that breast cancer is not as serious a problem as it once was," noted Marilyn Gentry, vice president for education for AICR.

"That simply is not the case," Ms. Gentry pointed out. She explained that in 1985 an estimated 38,000 women lost their lives to breast cancer, and that total new cases of breast cancer climbed to almost 120,000 across the United States.

"One of the real tragedies of breast cancer," Ms. Gentry noted, "is that it is one form of cancer where early detection is a key to successful treatment and the saving of lives. However, there are still only a small percentage of women performing regular, easy to do breast self-examination. That is why AICR is encouraging women to get these easy to follow instruction and reminder kits.

While there have been increases in both the number of cases of breast cancer and the number of deaths from breast cancer, both numbers have, for the most part, paralleled the general increase in population. If women would take a more active role on this health matter there exists a good chance for a reduction in those rates, according to Ms. Gentry.

Many studies have linked higher rates of breast cancer to diets high in fat. That is one reason why the American Institute for Cancer Research, a national cancer organization which focuses on diet, nutrition, and cancer prevention, has given breast cancer increased attention.

"Through more regular breast self-examination, and through simple dietary changes to reduce dietary fat, and to increase consumption of fruits, vegetables, and whole grain products, we feel there could be a significant reduction in breast cancer rates in this country," Ms. Gentry explained.

Free copies of the AICR breast self-examination instruction and reminder kits are available by sending a business-sized stamped, self-addressed envelope to American Institute for Cancer Research, Dept. BSE, Washington, DC 20069.

Caring for the *Dis-eased*

CAPT Joseph J. Bellanca, MC, USN

"Care more for the individual than for the special features of the disease."
Sir William Osler

"Good patient care" is an expression I have heard echoed and re-echoed in the Medical Department to the point it loses meaning. The expression is used at various times to signify selection of the theoretically correct treatment, the skillful application of appropriate diagnostic and therapeutic practices, and/or the positive interpersonal dynamic which occurs between two human beings involved in a healing relationship. Dr. Osler's quote cited above reminds us that what we do for diseased individuals may not be as important to the healing process as how we do it.

Although not reflected in the national mortality statistics, observation of both patients and "worried-well" for many years has convinced me that suicide is the most common preventable cause of death. I am referring to a slow method of suicide which is as universally fatal: worry, pessimism, and fear. We humans, including the professionals of the health care community, slowly kill ourselves with these deadly weapons. Such illness is not imaginary. It is *dis-ease*. It is just as lethal as cancer and may be more serious. When we expect the worst, the worst is what we invariably get. Even the ancients knew "seek and you shall find." We fail to realize that most afflictions and miseries are most often self-created because negative thoughts invariably produce negative results. We have lost confidence, faith, or whatever you want to call it—that things can go well. This short-circuits the enjoyment of health, the ability to cope adequately with life's problems, and the capacity to appreciate the marvelous positive aspects and happenings in our Navy health care system.

Faith as a virtue is not limited to religion. Real faith is not hope or desire; it is optimism which comes from within the mind of each individual. It is the result of the decision to be a creative force which makes good things happen, including good health.

Do you notice how many people around you, possibly including yourself, are worrying? Worry stems from fear, and fear is often a clear admission of lack of faith. How do fearful, worrisome thoughts make us *dis-eased?* To many health professionals, this seems irrelevant. To others, it is incomprehensible. They think of their minds and emotions as something totally different from their bodies, although this is contrary to what is believed by experts in psychosomatic medicine.

The mind and the body are not really separate entities, but are inseparably interrelated. What affects one affects both. Changes in the state of mind occur simultaneously with changes in the body. You can verify this with your own immediate experience. When you are angry, you are not affected only in your mind. Your face flushes, your pupils widen, your muscles tighten, and your blood pressure rises. None of these effects are imaginary. When such a state of mind is continual, it can lead to sickness just as serious as any caused by infectious agents or environmental pollution. The human body is heir to a thousand different ailments, and *dis-ease* is as common as all 999 others put together. When you observe the people around you, you can see the psychoneurosis of negative thinking, fear, and pessimism.

An effective, caring treatment for this common illness, whether it is found in you, your coworker, or your patients, is persistent optimism. It is hard work to be optimistic when everyone around you insists that life is a treadmill of problems.

Optimism requires dedicated, organized mind power to close the doors of the mind to everything that causes fear of impending catastrophe, and opens the windows of the mind to focus on what is miraculous and fantastic in our environment.

If you make a persistent effort to develop the habit of controlling your own negative reactions, you will begin to sense instinctively how your mind works. You will become aware of principles of thought, which you can consciously use to reverse negative reactions, *dis-ease,* and immediately stimulate new responses—responses in the direction of health and healing.

Do you feel negative about what you have read? Might you be a victim of negative attitude? Take some time to re-read and ponder these thoughts in your mind. Observe others, particularly those individuals around you who bring out strong positive or negative feelings in yourself. Then, if you become convinced of the power of personal interactions to influence the feeling of well-being, develop the habit of acting and speaking positively and observe the effect on those around you, particularly habitual complainers. Empathize and acknowledge their problems and feelings, but then encourage a look at the brighter side of things. Don't give into discouragement if your initial efforts fail. You can have a powerful healing effect on others by your behavior alone. Your own enthusiasm can be an infectious process engendering new patterns of more healthful feelings and behavior in patients. As noted earlier, Sir William Osler counseled "Care more for the individual!" □

Dr. Bellanca is commanding officer of the Navy Environmental Health Center, Norfolk, VA 23511-6695.

Photos by CDR D. Martin, USNR-R

First MECP Student Graduates

DTC W.R. Anthony, USN

During the recognition ceremonies at the University of Texas at El Paso, HM2 Cary ended his career as a hospital corpsman and became a Navy nurse. At the commissioning ceremony on 17 May 1986 RADM M.J. Nielubowicz, NC, Director of the Nurse Corps, administered the oath of office to ENS Dean P. Cary, NC, USNR, the first Navy member to graduate under the auspices of the Medical Enlisted Commissioning Program (MECP). RADM Nielubowicz also administered the oath of office to 2LTs Steven Bengston and Paul A. Kennedy, ANC, USA. RADM Nielubowicz was invited by Dr. Eileen M. Jacobi, Ed.D., R.N., F.A.A.N., dean of the College of Nursing and Allied Health, to address the graduating nursing; medical technology; and speech, hearing & language disorders students.

ENS Cary first enlisted in the Navy as a seaman in May 1976 and remained on active duty until May 1980. During this time he served aboard USS *Salinan* (ATF-161), attended Hospital Corps School, and was assigned to the Naval Regional Medical Center, Great Lakes, IL. He transferred to the Active Reserve in June 1980, where he remained until March 1982. In October 1982 he returned to active duty and was later transferred to the Naval Regional Medical Center, Orlando, FL. While stationed at Orlando, he applied to the MECP and was among the first group to attend college under the provisions of the program. Upon completing Officer Indoctrination School, ENS Cary will report to the Naval Hospital, San Diego, CA, for duty.

At other ceremonies across the country, the following MECP students were also commissioned Ensign, Nurse Corps, United States Naval Reserve:

Gloria A. Cerra—American University
Clifford W. Crawford—Pittsburgh State University
Donna M. Einhorn—Marymount College of Virginia
Jose A. Palafox, Jr.—California State University, Long Beach
Robert F. Profeta—State University of New York, Downstate
Frank R. Watkins—Stockton State College

The MECP affords outstanding hospital corpsmen and dental technicians the opportunity to attain the requirements for their bachelor of science degree in nursing. Selected members have up to 36 months to complete their training and will receive a commission as Ensign, Nurse Corps, United States Naval Reserve upon graduation. Selectees for this program receive full pay and allowances for their pay grade; however, they are responsible for all tuition, books, and associated fees for their schooling. For information on the application procedures and requirements, refer to the Navy Military Personnel Manual (NAVMILPERSMAN), Article 1020356, and watch for the annual Commander, Naval Medical Command, message soliciting applications (this message should be released during June 1987). For additional information contact: DTC W.R. Anthony, USN, MECP Program Manager, Naval Health Sciences Education and Training Command (Code 215), Bethesda, MD 20814-5022. Telephone: Autovon 295-0925/0170, Commercial (202) 295-0925/0770. □

RADM Neilubowicz administers the oath of office to ENS Gary and 2LTs Bengston and Kennedy.

DTC Anthony is program manager for the MECP at the Naval Health Sciences Education and Training Command (HSETC), Bethesda, MD 20814-5022.

Immunization Against Communicable Diseases

Bacterial Vaccines

CAPT Alfred D. Heggie, MC, USNR

Conclusion of a three-part series

Most presently available bacterial vaccines contain either whole bacteria or bacterial products that have been inactivated by chemical treatment. Meningococcal and pneumococcal vaccines are exceptions in that they contain purified polysaccharides of these bacteria. BCG vaccine, used in some countries for prevention of tuberculosis, is the only example of a currently available vaccine that contains live bacteria. However, live bacterial vaccines, particularly against enteric infections, are being tested.

Cholera Vaccine

Cholera vaccine contains cholera bacilli (*Vibrio cholerae*) that have been inactivated with phenol, washed, and suspended in sterile physiological saline. The vaccine does not prevent infection by cholera bacilli and appears to have little effect on the occurrence of disease. Therefore, the requirement for administration of cholera vaccine to Navy and Marine Corps personnel has been eliminated.

The principal means of protection against cholera is avoidance or decontamination of water and food that might be contaminated with cholera bacilli. Administration of cholera vaccine is indicated only in the course of international travel when necessary to comply with the entry requirements of host countries. For this purpose, only one dose (0.5 ml SC or IM) is usually required.

Diphtheria and Tetanus Vaccines

Tetanus and diphtheria are caused by toxins produced by tetanus and diphtheria bacilli (*Clostridium tetani* and *Corynebacterium diphtheriae*). Immunity to these diseases is induced by immunization with tetanus and diphtheria toxoids. Toxoids are bacterial toxins that have been chemically inactivated. In response to immunization with toxoids, the body produces antitoxins that prevent disease by neutralizing bacterial toxins.

Infants are usually immunized with a vaccine designated DTP that contains diphtheria and tetanus toxoids and inactivated pertussis (whooping cough) bacteria. The vaccine that is used to immunize adults against tetanus and diphtheria is designated Td. This indicates that it contains the same amount of tetanus toxoid as DTP or TD (a vaccine used to immunize children who cannot tolerate the pertussis component of DTP), but 1/12th the amount of diphtheria toxoid contained in DTP and TD. The dose of diphtheria toxoid is decreased in the vaccine for adults because adults tend to have developed increased sensitivity to diphtheria antigens as a result of having been immunized in childhood. The use of the lower dose of diphtheria toxoid reduces the frequency of adverse reactions to this component, which include pain, redness, and swelling at the injection site.

Serious reactions to tetanus toxoid are infrequent and no reduction in dose for adults is necessary. Severe

Dr. Heggie is an associate professor of pediatrics and pathology at the Case Western Reserve University School of Medicine, attending pediatrician in the Infectious Disease Division, Department of Pediatrics, and associate director of the Virology Laboratory, Department of Pathology, University Hospitals of Cleveland, Cleveland, OH 44106.

local reactions to tetanus toxoid may occur, however, as the lifetime total number of doses increases. Therefore, booster injections should be given only at the recommended intervals. For persons who have received three doses of tetanus adsorbed toxoid, alone or as Td, TD, or DTP at *any* previous time, a booster dose is required only every 10 years. The exception to this requirement is that persons who sustain extensive contaminated wounds (including, but not limited to, gunshot or missile wounds, crushing injuries, burns, animal bites, puncture wounds, and frostbite) should be given a booster dose of tetanus toxoid unless they were immunized or received a booster dose within the previous 5 years. More frequent use of tetanus toxoid is unnecessary and increases the risk of adverse reactions.

Meningococcal Vaccine

Meningococcal vaccine contains polysaccharide capsular antigens of groups A, C, Y, and W135 meningococci (*Neisseria meningitidis*). Administration of this vaccine is required only for Navy and Marine Corps recruits because recruits participating in basic training are at increased risk of developing meningococcal meningitis or meningococcemia. The vaccine may also be used in other personnel when it is determined by cognizant authority that there is an increased risk of meningitis or meningococcemia caused by the groups of meningococci contained in the vaccine.

Unfortunately, the most frequent cause of meningococcal disease in the United States is the group B meningococcus and at present no vaccine is available for immunization against this strain of the organism. Meningococcal vaccine is supplied in 50-dose vials for subcutaneous administration by jet injection only.

Plague Vaccine

Plague vaccine contains formaldehyde-inactivated plague bacilli (*Yersinia pestis*) suspended in sterile physiological saline. The effectiveness of plague vaccine in protecting against infection has not been proved but its use seems to reduce the severity of the disease. Periodic booster doses of vaccine appear to be required to maintain this partial immunity. See Part I, Table 2 for the required basic series for primary immunization. Plague vaccine must be injected intramuscularly by syringe and needle. Use of the jet injector is prohibited for this vaccine. Care that injections are given intramuscularly is important because subcutaneous injection of plague vaccine often causes a painful local inflammatory reaction.

Booster injections are necessary only for personnel operating in areas where plague is highly endemic and in certain occupational groups whose activities may result in exposure to infected rodents and their ectoparasites. In these situations, booster doses should be given at 6-month intervals until three boosters have been given. With repeated doses of plague vaccine, reactions such as fever, headache, and malaise become more frequent and severe. Therefore, boosters should be considered only for personnel who are at exceptionally high risk of exposure to plague.

Typhoid Vaccine

When reconstituted with the special diluent supplied, typhoid vaccine consists of a suspension of typhoid bacilli (*Salmonella typhi*) that have been inactivated by treatment with acetone and heat. No live bacteria are present. Immunization is estimated to produce protection against typhoid fever in 60-65 percent of exposed recipients. Resistance to infection, however, is related to the intensity of exposure. Massive exposure may result in disease even in persons who have received typhoid vaccine. Therefore, sanitation measures are more important than immunization in the prevention of typhoid fever.

The requirement for primary immunization with typhoid vaccine has been changed from two to one SC or IM injection (0.5 ml) because the second injection produces only a slight increase in protection against typhoid and is often associated with adverse reactions. The partial immunity conferred by the vaccine is temporary and booster doses are required every 3 years in personnel operating in typhoid endemic areas.

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A Review:

Surgery for Sleep Apnea

LCDR Patrick T. Choong, MC, USNR

Obstructive sleep apnea is a condition that has been recognized relatively recently. Various nonsurgical methods of treatment have been tried for this condition, such as drugs, diets, weight loss, and changing sleep positions. However, these have generally been unsuccessful in curing the condition. It has only been in the past 6 years that surgical procedures, other than tracheotomy, have been developed for obstructive sleep apnea with some success.

The sleep apnea syndrome is defined as 30 or more episodes of cessation of airflow of more than 10 seconds duration during non-REM sleep in 7 hours. Sleep apnea is further divided into three types. *Central* apnea is a condition in which the respiratory center fails to initiate a respiratory effort. *Obstructive* sleep apnea is when airflow is peripherally blocked in the presence of continued respiratory effort. *Mixed* apnea is a combination of both central and obstructive apnea, where a cessation of respiratory effort is followed by interruption of airflow when respiratory effort resumes.

Most sleep apnea patients will experience 100 or more episodes of apnea each night. Males tend to outnumber females, and males in the fifth decade are the most affected group. Obesity is usually but not always associated with obstructive sleep apnea.

Dr. Choong is chief, Department of Otolaryngology, Naval Hospital, Philadelphia, PA 19145-5199.

Obstructive Sleep Apnea

Obstructive sleep apnea syndrome is characterized by excessive daytime sleepiness, fatigability, mood changes, increased hostility, decreased performance, poor memory, and poor judgment. Nighttime symptoms include loud snoring interrupted by episodes of apnea, restlessness, nocturnal enuresis, nightmares, and insomnia.

Any obstructive abnormality of the upper airway can cause obstructive sleep apnea. Among these are deviated nasal septum, hypertrophied tonsils and adenoids, supraglottic edema, vocal cord paralysis, laryngeal webs, and retrognathia. By far, the most common cause of obstructive apnea, as proven by videoendoscopic studies, is the collapse of the velopharyngeal and pharyngeal airspace. Due to the lack of a skeletal framework, this airspace is maintained by the reflex activity of the musculature of the pharyngeal walls, soft palate, and tongue. In obstructive sleep apnea, there is an apparent loss of tone of these muscles during sleep, leading to the collapse of the pharyngeal walls and soft palate inward, thus closing the airway. The reason for this remains a mystery. This loss of muscle tone is usually accompanied by loud snoring noises just prior to the complete closure of the airway. The apneic episode is terminated by a sudden opening of the pharyngeal airway accompanied by a brief arousal of the patient. This cycle is repeated several hundred times a night.

The glottis does not appear to be involved in obstructive sleep apnea. Videoendoscopic studies have repeatedly shown a wide open glottis during the apneic episode. The tongue elevates and comes in contact with the junction of the hard and soft palate, thereby closing the oral airway. It does not, however, fall back posteriorly to come in contact against the posterior pharynx, as was postulated in obstructive sleep apnea secondary to retrognathism.

Diagnosis of obstructive sleep apnea is by polysomnographic studies. A thorough physical examination is of utmost importance to evaluate any abnormalities of the upper airway. Polysomnographic monitoring of the patient during sleep evaluates respiratory irregularities, changes in blood gases, cardiac arrhythmias, and EEG changes. Airflow is monitored by means of nasal and oral thermistors. Respiratory effort is measured by abdominal or chest wall movements, or esophageal manometry. Cardiac changes are monitored by continuous ECG. Blood gases are drawn periodically, and sleep stages are evaluated by continuous EEG and electro-oculometer monitoring. A fiberoptic nasopharyngoscope may also be applied to the sleeping patient.

Typically, patients with obstructive sleep apnea spend a substantial amount of time with O_2 saturations below 80 percent and not uncommonly below 50 percent in more severe cases. The most common cardiac

arrhythmia encountered is bradycardia and sometimes premature ventricular contractions. Apneic episodes may number in the hundreds.

Surgical Resolution

Surgical therapy is only recommended for obstructive sleep apnea. The time honored and most effective surgical procedure for severe obstructive sleep apnea has been a permanent tracheotomy. In the past half decade several more site-specific procedures for obstructive sleep apnea have been developed, such as uvulopalatopharyngoplasty (UPPP) and mandibular advancement. Data is still being gathered on the effectiveness of these procedures. However, at the present time they appear to offer an alternative to tracheotomy in selected patients.

Prior to any of these procedures, other obstructive abnormalities of the upper airway such as deviated nasal septum, hypertrophic tonsils and adenoids, and laryngeal lesions, should first be corrected. In children, the removal of hypertrophic adenoids and tonsils frequently result in the curing of the obstructive sleep apnea.

Tracheotomy bypasses the site of obstruction and has proven successful in curing the patients of their sleep apnea and related symptoms. Several techniques of permanent tracheotomy have been reported. Some are merely the standard tracheotomy procedure with the insertion of an indwelling silastic flanged or T-tube. Others involve the creation of tracheal and skin flaps, and the rotation and approximation of these flaps with sutures. This creates a skin-lined stoma that obviates the need for a tracheotomy tube.

While curing obstructive sleep apnea in almost every case, tracheotomy is not without its problems. The patient must now live with a hole in the neck, which some may consider cosmetically unacceptable. The patient is also burdened with a strict regiment of hygiene and stomal care. Secretions and crusting can be a constant problem. There is also the problem of a decrease in voice quality, especially if a poor stomal seal is obtained. The patients usually plug their stoma during the waking hours and leave them unplugged at night. In spite of the problems encountered, the advantages of tracheotomy in severe obstructive sleep apnea far outweigh the disadvantages. Spouse and family support is very important, as is a well-informed patient.

Sleep studies performed following tracheotomy have generally shown a drastic reduction of apneic episodes to normal levels. The procedure is so consistent that it is generally felt that if tracheotomy does not result in the decrease in apneic episodes, then the diagnosis of obstructive sleep apnea is in error.

Retrognathism has been associated with some cases of obstructive sleep apnea, and mandibular advancement has been performed with some success of these patients. The procedure involves bilateral mandibular osteotomies and bone grafts to advance the mandible. Prior to this, sleep studies should be performed with the patient fitted with an occlusal splint constructed to force the mandible forward. An improvement in apneic episodes should be noted if the patient is to be helped by surgical advancement of the mandible.

The proposed etiology of retrognathism and obstructive sleep apnea is the posterior displacement of the tongue to the posterior pharynx. However, this mechanism has not been substantiated by videoendoscopic sleep studies. It must be noted that while obstructive sleep apnea may be associated with retrognathism, most people with retrognathism do not have a problem with sleep apnea. The effectiveness of mandibular advancement is still to be determined, as the procedure has been performed on a small number of sleep apnea patients thus far.

UPPP was first described by Fugita in 1981, and has since been advanced by Simmons and others, for obstructive sleep apnea and severe snoring. The results so far have been encouraging for select patients.

The procedure involves first a tonsillectomy, if tonsils are still present, with careful preservation of the anterior and posterior pillars. The posterior margin of the soft palate is then resected along with the uvula and half the anterior tonsillar pillars. The resection is carried back to the thick muscular part of the soft palate. The amount of palate resected at the midline is usually about 1.5 cm. The posterior tonsillar pillars are then pulled forward and sutured to the resected edge of the anterior tonsillar pillars, using polyglactin sutures. A mucosa to mucosa closure is then performed on the resected edge of the soft palate.

Postoperative care is the same as for tonsillectomy. Pain medication should preferably be non-narcotic to avoid excessive sedation. The patient should be monitored and observed closely the first postoperative night. The patient may be discharged from the hospital when able to maintain oral fluids. Postoperative sleep studies should be performed in 3-6 months.

There have been few serious complications reported. Transient nasal regurgitation of fluids has been reported in some patients, which resolved without treatment in most cases. A small number of patients developed hypernasal speech, and dryness of the hypopharynx was experienced by some.

The effectiveness of UPPP is encouraging. Success was determined by the return of O_2 desaturations during sleep to at least 85 percent, or an improvement of at least 50 percent of the preoperative level. While only 45 percent of the patients, in one study, were considered to have successful results by postoperative polysomnogram, 87 percent reported improvements in symptoms such as better sleep, less daytime sleepiness, and decreased snoring. In all cases, snoring resolved or decreased to acceptable levels.

Obviously UPPP is not recommended for all patients with obstructive sleep apnea. Some general guidelines have been suggested to identify the patient who might benefit from this procedure. Patients with central sleep apnea are not candidates

for any surgical procedure. Tracheotomy not UPPP is the procedure of choice for the morbidly obese patient. UPPP is also contraindicated for patients with retrognathia. These patients may benefit from mandibular advancement.

From the results of preoperative sleep studies, patients who have O_2 desaturations of less than 50 percent for much of the time, and patients who develop significant arrhythmias should have tracheotomy instead. Those with O_2 desaturations between 60 percent to 80 percent and have no life-threatening arrhythmias are considered to have the best chance of benefiting from UPPP. UPPP may be performed in conjunction with tracheotomy. Followup sleep studies are then performed with the tracheotomy plugged. If there is satisfactory improvement in O_2 desaturation and apneic episodes, then the tracheotomy may be reversed.

UPPP has proven to be very effective in the treatment of severe snoring. In almost all cases snoring is either resolved or greatly reduced. In the absence of a history or symptoms of sleep apnea, preoperative sleep studies are necessary only if a 24-hour cardiac monitor (Holter) reveals cardiac arrhythmia during sleep.

Summary

Obstructive sleep apnea is a condition that physicians and the informed public are becoming more aware of. Diagnosis is now possible through sleep studies, and sleep disorder centers are being established at an increasing rate. The treatment of obstructive sleep apnea appears to be surgical. Tracheotomy is not most effective, but least desirable. UPPP is a new procedure developed for select cases of obstructive sleep apnea and is encouraging. Mandibular advancement may be beneficial in patients with retrognathia. While the present data is incomplete, these procedures appear to hold promise as an alternative to tracheotomy in the treatment of obstructive sleep apnea.

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USS *Norton Sound* Reunion

The USS *Norton Sound* (AV-11/AVM-1) Association will sponsor its 15th annual reunion 24-28 Sept 1986 at Port Hueneme, CA.

All interested Association members, current and former Norton Sounders, members of attached military units, civil service, and contractor personnel who have served aboard during any period of her 41-year history of service to the Nation are invited to attend.

For more information contact: Robert Hovestadt (805) 485-6144, Clyde Taylor (805) 642-1413, or USS *Norton Sound* Association, P.O. Box 487, Port Hueneme, CA 93041.

Titanium Dental Crowns Tested

Titanium could offer dentists a practical alternative for gold and imported metals currently used in dental crowns if the material proves itself in clinical studies now being conducted at the Commerce Department's National Bureau of Standards (NBS).

The first precision casting of a pure titanium dental crown in the United States was made recently in the dental laboratories of the Paffenbarger Research Center (PRC) of the American Dental Association Health Foundation at NBS.

"If titanium performs as well as traditional gold alloys, it could replace the more expensive material for dental restorations, as well as the use of imported nickel, cobalt, and chromium for dental appliances," says Dr. Nelson W. Rupp, associate director of PRC and the first volunteer patient to receive a titanium dental restoration.

Rupp's crown and those being made for other volunteer patients will be observed by PRC/NBS scientists for at least 2 years.

"We are interested in learning if the titanium crowns fit accurately enough to prevent recurrent tooth decay. We also will be looking for any effect the metal may have on the gingival "gum" tissues and how the titanium affects the buildup of plaque," says Rupp.

In addition to studying the wear of titanium crowns and their effect on opposing teeth, the scientists want to know if the volunteer patients notice any unusual taste from the metal, and whether there is any galvanic reaction between titanium and other restorative amalgams.

Titanium alloys have been used for several years in surgical implants for such things as hip joint replacements. The metal has remarkably good compatibility with human soft tissues and bone, and laboratory tests in artificial saliva show it has a corrosion resistance that exceeds the performance of nickel, cobalt, and chromium alloys.

Even though titanium implants have performed well in the body, the metal has been ignored by dental manufacturers and researchers. They have felt the metal was too difficult to cast with the precision required for dental use. Titanium has a very high melting temperature (about 1,700 C) and the metal is extremely reactive to its environment. It must be cast in an inert gas atmosphere to prevent oxygen embrittlement, a problem that can take place when the molten metal is exposed to air, and it must be protected from chemical contamination by crucibles and molds.

A breakthrough for preventing oxygen embrittlement and contamination in dental castings has been made by Dr. Richard M. Waterstrat, a physical metallurgist with the PRC at NBS. Waterstrat has developed a new electric-arc furnace for making precision castings of strong, lightweight, pure titanium dental crowns in an air-free environment. The furnace also has a water-cooled crucible that prevents chemical contamination to molten metals.

Waterstrat, who successfully made the world's first titanium-based dental casting in 1977, says his furnace now is simple enough that dentists can easily use such a device in clinics. It can even be used to melt metals at temperatures above 3,000 C.

"The cost of metal for a typical titanium dental casting is comparable to nickel, cobalt, and chromium alloys now frequently used to replace the more expensive gold," says Waterstrat. Furthermore, he points out that titanium is available in the United States and offers dentists a practical alternative for imported metals that may be in short supply or required for strategic use.

While titanium crowns currently are being cast in Japan and Switzerland, the PRC/NBS researchers say the high quality of the dental castings made at NBS can be attributed to a special zirconia-based material used for the molds. The material produces an extremely smooth surface and eliminates the problem of surface porosity and roughness found in other titanium dental castings.

The titanium crowns produced by Waterstrat's technique appear to require only minimal preparation before use by dental practitioners. The titanium material is easier to grind and polish then nickel-chromium and cobalt-chromium alloys.

CAPT R.W. Hinman, an NBS research associate sponsored by the Navy, and CAPT D.L. Pfeifer, DC, provided assistance on the first clinical trial. A recommendation to use titanium for crowns and other dental castings by dental practitioners would be made only after a careful review of the PRC/NBS clinical results.

The electric-arc furnace technique for casting titanium dental crowns is the latest milestone in a long list of accomplishments from the cooperative research program between ADA and NBS that was established in 1928.

—National Bureau of Standards

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